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MODERN METHODS OF TREATING ENAMEL CARIES: MICROABRASION AND INFILTRATION

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Annotation;Despite a significant decrease in the prevalence and intensity of carious disease in the world over the past 20-30 years, this problem remains relevant in many countries, including Russia. According to a systematic review, which summarized data from 378 studies for 1990-2010, caries of permanent teeth is the most common disease worldwide. Its prevalence has not changed in 2 decades and averages 35% (2.4 billion people). The high incidence of caries complications (pulpitis and periodontitis) is the main cause of tooth extraction. All this has a negative impact on the dental health of the population. Due to the fact that the prevalence of caries increases with age, dentists are increasingly faced with this problem against the background of the aging trend of the population.

In recent years, the technologies of the so-called biomimetic mineralization, which involve the use of proteins that stabilize calcium and phosphate ions, capable of controlling the process of (re) mineralization, have earned the close attention of scientists. Bioavailable combined preparations consisting of casein-phosphopeptide — CPP and amorphous calcium phosphate — ACP have become the most widespread. CPP contains active sequences Ser (P)-Ser(P)-Ser(P)-Glu-Glu, responsible for combining casein with calcium and phosphate ions into nanoclusters with a size of 2.12 nm; one CPP molecule is capable of binding 25 calcium ions and 15 phosphate ions. CPR preserves calcium and phosphate in an amorphous non-crystalline state, making them bioavailable at neutral pH values and providing high adhesion of the drug to hard tooth tissues, pellicle, plaque components and soft tissues of the oral cavity, which significantly prolongs the effect of the drug [16]. The effectiveness of CPR-ASR for enamel remineralization has been proven in comparison with placebo. However, so far clinical studies, including systematic reviews, do not allow us to assert the proven advantages of these drugs over fluoride-containing drugs. The authors of reviews devoted to remineralizing therapy almost unanimously note the lack of high-evidence studies on the comparative analysis of various means of enamel remineralization and methods of their application, as well as the need to continue the search and testing of new means.

The caries infiltration method and its effectiveness

Since the development of the carious process is accompanied by an increase in the porosity and permeability of the enamel, an alternative way to treat the initial forms of caries is to close the enamel pores — the "gate" for the penetration of acids and the release of dissolved minerals. To close the pores, a material with the following qualities is needed: after application, to have hydrophilic, and after polymerization, hydrophobic properties; to be surface—active and have low viscosity; to have bactericidal or at least bacteriostatic properties, while being well tolerated by dentin, pulp and soft tissues surrounding the tooth; to be ideally self-polymerizing, after polymerization, provide some mechanical support to the tooth tissues; be convenient to use, commercially available, and affordable.

According to the recommendations of the manufacturer of the Icon system, caries infiltration is used to treat enamel caries at the stage of a white spot on the vestibular surfaces of teeth; enamel caries and dentin caries when it is affected up to half the thickness on the approximal surfaces of teeth while maintaining a pseudo-contact layer and superficial carious lesions of dentin at the level of the enamel-dentin border.
The advantage of the method lies in its atraumatic nature, relative speed (after installing a cofferdam, treatment of one area takes only 15 minutes), and complete preservation of the tooth shape. After enamel infiltration, dynamic monitoring is necessary (at least once a year) with regular X-ray monitoring.
Significant decrease in fluorescence of tooth tissues in the area of demineralization withInformation about the long-term results of the caries-infiltration method is scarce. In a randomized study in patients with enamel lesions on the frontal surface of teeth after removal of orthodontic devices with the use of caries infiltration, according to spectrophotometry data, restoration of tooth color and gloss was noted, which persisted for 6 months. On the control teeth, the spectrophotometry indicators were significantly worse.
In a randomized trial with blind placebo control conducted in 5 private German clinics with 87 patients, 238 pairs of proximal carious lesions were treated, to which caries infiltration (test) or imitation of the procedure (control) were randomly applied. The X-ray results were evaluated by experts who did not know how a particular tooth was treated. After 10 months, caries progression was recorded on 2 (2%) of 92 test teeth and on 22 (24%) of 92 control teeth ($p=0.001$); after 18 months — on 10 (5%) of 186 test teeth and on 58 (31%) of 186 control teeth ($p<0.001$). The authors conclude that caries infiltration has a significant positive effect compared with placebo [30]. Of particular interest are studies comparing caries infiltration with other methods of treating initial enamel caries. A. Turska-Szybka et al conducted a randomized study on 81 children with baby teeth: 41 of them had caries infiltration and fluoride varnish, and 40 patients had teeth treated only with fluoride varnish (control group). After 1 year, the absence of caries progression was noted in 92.1% of children in the test group and in 70.6% of the control group ($p<0.001$). In a similar randomized study involving 50 children with baby teeth, K. Ekstrand et al. Compared the effect of caries infiltration in combination with fluoride varnish (test) with the treatment of teeth only with varnish (control). After 1 year, the ICDAS index progressed by 31% of test teeth and by 67% of control teeth ($p<0.01$). Radiological progression was noted in 23% of test and 62% of control lesions ($p<0.01$). Thus, the clinical and radiological effectM. Aziznezhad et al. [33] compared the effect of three mineralizing materials — the Icon infiltration system, fluoride varnish and nanohydroxyapatite paste (Nano P) — on the surface hardness of enamel and adhesion of Streptococcus mutans in the area of initial caries on 60 healthy teeth with artificial enamel damage. The Vickers microhardness was measured initially, after the creation of an artificial enamel lesion and after treatment with a remineralizing material. All 3 materials increased the hardness of the enamel, but only in the case of Icon, the hardness reached its initial values, and the effect of fluoride varnish was the least. The level of bacterial adhesion (in COE/ml) was highest on hypomineralized enamel (7883±7155), followed by the degree of reduction: intact enamel (4652±3959) treated with Icon (500±299), Nano P paste (78±53) and fluoride varnish (no bacteria). Thus, caries infiltration restored the mechanical characteristics of enamel better than other remineralizing drugs, fluorideSome authors emphasize that violation of the technique of applying Icon Etch, Icon Dry and Icon Infiltrant entails a significant deterioration in the result of treatment, the risk of developing secondary caries along the periphery of the filtered enamel area in the long term (1-1.5 years), insufficient and time-unstable aesthetic effect of treatment associated with incomplete obturation of micropores in the surface layers enamel and their subsequent filling with cariesogenic microorganisms. According to some authors, infiltration of initial caries in the pigmented spot stage does not guarantee stabilization of the carious process.
In foreign systematic reviews devoted to the analysis of the effectiveness of microinvasive methods of treatment of initial caries, both the effectiveness of caries infiltration and the insufficiency of comparative studies of high evidence for making final conclusions about the relative advantages of various techniques are noted.

The microabrasion method and its effectiveness

According to the literature, proposals to remove stains on tooth enamel using acids have been made since the beginning of the twentieth century. In 1986, T. Croll and R. Cavanaugh proposed using a mixture of 18% hydrochloric acid with laboratory pumice stone to restore the aesthetic appearance of enamel with a slight loss of its surface. Due to the strong etching effect of 18% HCl, lower concentrations of hydrochloric

acid, citric acid and phosphoric acid were tested for microabrasion, and synthetic diamond dust, aluminum oxides and silicon carbide were used as an abrasive material.

This technique, called "enamel microabrasion", offered a conservative approach to removing enamel stains of any etiology and correcting uneven enamel surfaces, for example after removing orthodontic devices [39]. The lesion should have a firm texture and be limited to the surface layer of enamel. Subsequent experience with microabrasion has confirmed that the etiology of enamel color changes does not affect the effectiveness of this technique. According to R. Sundfeld et the thickness of the removed enamel layer is 25-200 microns, depending on the acid concentration and the number of treatments. In an in situ study, the surface morphology and microhardness of tooth enamel were studied after treatment with 35% phosphoric acid (H3PO4) with pumice or 6.6% HCl with silicon dioxide. Some of the teeth after microabrasion were treated with saliva for 1 hour, 24 hours or 7 days. Microabrasion caused a significant decrease in the microhardness of the enamel compared to the control. But after exposure to saliva, the microhardness of the enamel treated with hydrochloric acid and silicon dioxide was almost equal to the control, whereas after treatment with phosphoric acid with pumice, the recovery was incomplete. These results were confirmed by electron microscopy data on the morphology of the enamel surface. Currently, effective microabrasive commercial products have been developed, such as Prema Compound and Opalustre, which contain a low concentration of hydrochloric acid (10 and 6%, respectively) and a fine—grained abrasive - silicon carbide. The literature describes the use of microabrasion to correct the color of teeth with fluorosis and discolorites of other etiology in localized or idiopathic superficial enamel hypoplasia , for the prevention and correction of enamel defects after removal of orthodontic devices , for the treatment of caries in the stage of white spot. Pliska in an in vitro study, the effect of CPP-ACP-containing paste, microabrasion, and a combination of paste with microabrasion on artificially induced enamel caries at the white spot stage was evaluated. Using the method of quantitative light-induced fluorescence, it was shown that the mineralization of carious lesions was significantly higher after microabrasion and microabrasion in combination with CPP-ACP-containing paste, but not after treatment with paste alone. M. Akin and F. Basciftci compared the effectiveness of conventional oral hygiene (group 1), fluoride-containing rinses (group 2), CPP-ACP-containing paste (group 3) in 80 patients with caries at the white spot stage after removal of orthodontic devices (966 affected teeth) and microabrasion (group 4). The area of white spots significantly decreased in all groups. The largest reduction was observed in group 4 (97%), the degree of lesion reduction in group 3 (58%) was significantly greater than in groups 2 (48%) and 1 (45%). The authors concluded that microabrasion has a greater cosmetic effect on caries in the white spot stage than remineralizing therapy with fluoride and CPP-ACP-containing agents. These results are consistent with the above experimental comparative studies.

Conclusion

Taking into account the disadvantages of modern remineralizing therapy, scientists continue to search for new mini- and microinvasive methods of treating initial caries.

Caries infiltration has demonstrated its effectiveness in the treatment of initial caries relative to placebo and some types of remineralizing therapy, however, comparative studies are few and for the most part conducted in laboratory conditions. Publications devoted to evaluating the effectiveness of microabrasion in the treatment of initial caries also predominantly describe individual cases or a series of observations.

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